

# EXHIBIT 12



OPEN CONNECT

## Netflix Open Connect Deployment Guide

This guide describes the deployment of embedded Open Connect Appliances. If you are interested in peering or an overview of the Open Connect program, see the [Open Connect web site](#).

**Last Updated:** 13 April 2021

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## Summary of the embedded OCA deployment workflow

This article summarizes what partners can expect during the deployment process for embedded OCAs.

The deployment workflow starts after you and your partner engagement manager (PEM) have determined that one or more OCAs will be sent to you. This workflow fits into our overall engagement workflow as described on the website in Step 5 (site survey) : <https://openconnect.netflix.com/en/#how-to-get-started>

- [Site Survey \(new or RMA\)](#)
- [Partner Portal invitations](#)
- [Shipping Details](#)
- [Allocation, pre-fill, and network configuration](#)
- [Shipping / Receiving / Installing OCAs](#)
- [Turn-up / Burn-in](#)
- [Live / Monitoring](#)

### SITE SURVEY (NEW OR RMA)

A *site survey* is a form that Netflix Open Connect uses to collect the information that we need in order to configure and ship OCAs to our partners. For new OCAs, your PEM will initiate a site survey. For RMAs, our Operations team will typically initiate a site survey. In either case, your identified contact will receive an email with a link to our [Partner Forms application](#), where your team will fill out shipping, contacts, and network configuration details.

For existing partners with Partner Portal access, you can also access the Partner Forms application from the **Forms** pages in the Partner Portal.

### PARTNER PORTAL INVITATIONS

After you complete and submit the site survey form, any new Engineering or NOC contacts that you identified in the form are invited to the Open Connect Partner Portal. An invite email is sent out with a link and instructions for how to active your portal account. If you are a brand new partner, this is a good opportunity to [add additional portal users](#) as needed.

For more information about what you can do in the Partner Portal, see the [related articles](#) in this help center.

**Note:** All of the subsequent emails referenced in this article are [visible for your reference in the Partner Portal](#).

## SHIPPING DETAILS

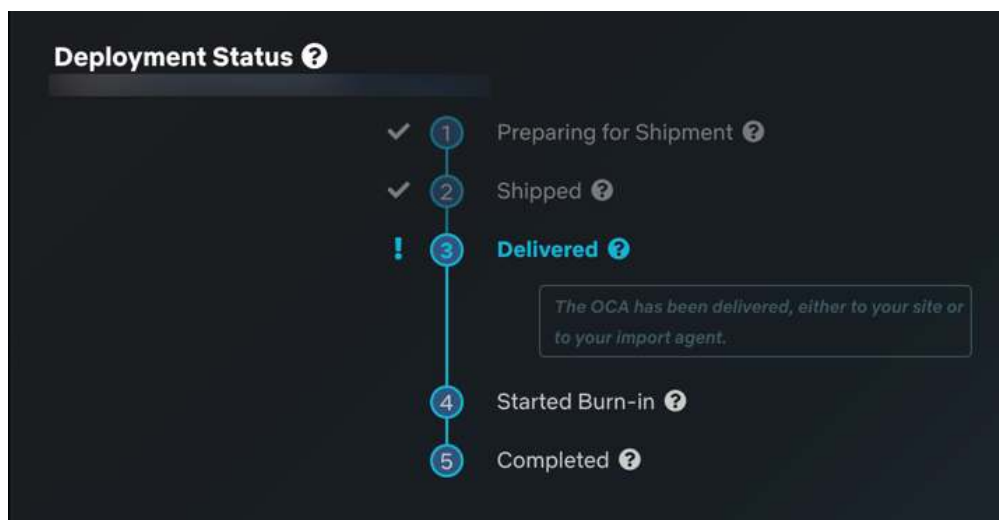
After you submit the site survey form, shipping details are finalized by the Open Connect logistics team in coordination with the shipping (and optionally, customs contact) that you identified in the site survey. After shipping details are agreed on and any necessary customs and import paperwork has been generated and approved, the shipping preparation process begins.

## PREPARING FOR SHIPPING

Contacts identified in the site survey receive an email when the shipping preparation process starts. Based on the hardware requirements for the deployment, we allocate specific hardware to your deployment and begin the process of pre-filling the OCAs with the appropriate catalog for your region. When the OCAs are done filling with content, we ship them to you.

## SHIPPING / RECEIVING

Contacts in the site survey receive an email when OCAs have shipped. A tracking number is provided in the email. During the shipping process, your OCAs are visible in the Partner Portal, with a tracking diagram that reflects the current state of the shipment.



After OCAs are delivered to you, site survey contacts will receive another email letting you know. It is important to physically install OCAs as soon as possible after delivery. This avoids having the pre-filled content become stale, requiring a lengthy on-site fill cycle before OCAs can begin to serve client traffic.

For more details about the shipping and receiving process, see **the Shipping and Receiving section** in the Deployment Guide.

## INSTALLING OCAS AND ESTABLISHING BGP SESSION(S)

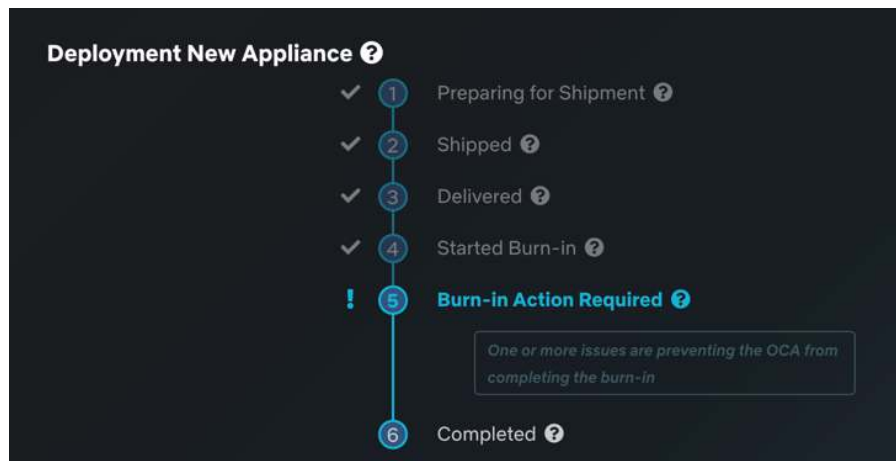
After OCAs are installed, connected to the internet, and a BGP session has been established with the appliance, they will begin to report health metrics and received routes to our control plane services. At this point, our systems are triggered to automatically begin the burn-in process.

For more information about the installation process, see **Racking and Physical Installation of OCAs**.

## BURN-IN

You will receive an email when the burn-in process starts. During this process, the OCA will begin to receive fill traffic to bring the content catalog up to date. Assuming that the appliance was installed within a **reasonable amount of time** after receipt, the fill process generally takes about two days. If installation was delayed, the fill process can take longer.

In parallel, multiple status and health checks are periodically run on the appliance. You will receive emails with the results of each check and information about how to fix any failed checks. If an OCA is failing checks, the tracking diagram will indicate this state.



**Reminder:** You can view details about passing/failing burn-in checks and other emails on the **Emails** page in the Partner Portal.

Appliances will not start serving client traffic until all checks pass and acceptable offload can be achieved. When the system is ready, the appliance is automatically enabled to serve clients and you will receive an email indicating that the OCA is live. At this point, the status for the OCA in Partner Portal will also switch to "Live". The Open Connect Operations team will then continue to monitor its performance.

## LIVE / MONITORING

The Open Connect Operations team constantly monitors OCA status and performance via our internal alerting and monitoring tools. Periodic software upgrades will automatically occur. These upgrades are timed to avoid peak traffic hours and typically do not require any action on your part. Engineering and NOC contacts in your organization will be notified via email when they start, and again when they finish. If any issues ever occur that require partner assistance, a ticket will be opened and your **Engineering** and **NOC** contacts will be notified about the ticket via email.

**Reminder:** If you need to power down an OCA in order to perform maintenance, you should disable it beforehand to gracefully **drain it of any live traffic** using the Partner Portal. Following this process will minimize any customer impact.

If you require assistance of any kind throughout this process or afterwards, **open a ticket**.

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## Requirements for deploying embedded appliances

The overall goal of Open Connect Appliance (OCA) deployment is to provide the best experience possible for Netflix viewers with a design providing maximum resiliency and localizing traffic as much as possible to optimize ISP resources. The following criteria have led to successful OCA deployments at a substantial number of global ISPs and are requirements for consideration.

### NETWORK AND DATA CENTER CRITERIA

Criteria	Description
Network	Your ISP should have a <b>public</b> autonomous system number (ASN) that you are able to use for peering
Netflix Viewer Traffic	For offload efficiency and system scale, we require a minimum of <b>5 Gbps of peak Netflix traffic</b> per deployment site
Network Capacity	Each site must have the capacity to handle <b>1.2 Gbps of inbound traffic daily</b> for a 12-hour period per appliance for <b>fill and updates</b> . Fill is scheduled to happen during low traffic times to maximize offload.
Interconnection	You must connect to Netflix via SFI (peering) at one or more Netflix <b>points of presence (PoPs)</b> if it is possible to do so.
AWS Connectivity	<p>OCA's and clients must be able to communicate with the control plane services running in Amazon Web Services (AWS). If connectivity to AWS is lost, OCA's will stop serving traffic.</p> <p><b>Note:</b> You can confirm the status of required inbound/outbound OCA connectivity <b>in the Partner Portal</b>.</p>
Installation	You must be able to <b>physically install</b> OCA's at your assigned site within <b>10 business days of receipt</b> , or as soon as possible thereafter
Consistent room temperatures	No higher than <b>78°F (26°C)</b>

Maximum room temperatures	No higher than <b>104°F (40°C)</b> for very short periods of time only
Physical Connection	You must be able to provision <b>2-4 x 10 Gbps ethernet ports in a LACP LAG</b> (or <b>1 X 100G</b> for some OCA versions) per OCA. The exact quantity depends on the OCA type.
Maximum Power Supply Draw	750W

## TEAM ROLES

To participate in the OCA program, you will need to identify a person or a set of people who are available to perform the following roles. Your team members will work closely with the corresponding members of the Netflix team to facilitate the overall process.

Partner Role	Description	Corresponding Netflix role(s)
Engagement Manager	The main point of contact for the Netflix Open Connect Partner Engagement Manager (PEM)	Netflix Open Connect PEM
Legal Representative	Reviews and accepts the legal agreements that are required for OCA deployments	PEM, Open Connect Legal, Open Connect Business Operations
Network Engineer	Provides information about partner sites, OCA configurations, maintenance, and network routing	PEM, Open Connect Operations
Logistics Representative	Directs the shipment of OCAs  Your logistics representative should be involved at the beginning of the engagement process to avoid shipping delays at later stages of the process	PEM, Open Connect Logistics, Open Connect Operations
Data Center Operations	<b>Installs OCAs on the partner network</b>	Open Connect Operations
Network Operations	Works with Netflix to troubleshoot routing and other configuration issues that might arise	Open Connect Network Engineering, Open Connect Operations



## TRAFFIC ANALYSIS AND SIZING

After Netflix receives your **OCA request**, a PEM will review recent peak traffic to Netflix viewers on your ASN. In general you will receive a response within 10 business days from submitting your request.

For ISPs who have one or more sites that meet the 5G threshold, additional capacity planning activities will be initiated. The first steps are to forecast per-site capacity and network configuration requirements in conjunction with your network planning and engineering teams. This includes analysis of traffic patterns within the various regions of your network, determination of the appropriate type and count of OCAs for each location, and a review of resiliency options.

The number of appliances to be deployed are determined by three general factors:

- Your overall network architecture requirements
- The peak Netflix traffic to be delivered from a given site
- The availability and failover options possible for a given site

Once appliances are deployed, the Netflix team will work with you to forecast future demand to ensure that your OCA configuration will accommodate future peaks of traffic. Appliance performance is monitored by the Open Connect Operations Team who will contact you if there are any issues with performance or the hardware itself. Note that per the Partner Maintenance section of the **Open Connect Deployment Guide** the only field-serviceable components are optics and power supplies. Any other hardware needs are met through our RMA process as described in the **Returns and Replacements** section of the guide.

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## Shipping and Receiving OCAs

Netflix's logistics suppliers have different requirements for shipping, importing, and customs processes that are specific to each country in which an ISP might operate. During the engagement process with Netflix, the shipping specifics for your country and deployment will be reviewed with you and agreed upon.

### SHIPPING OCAS

Before shipping OCAs to your facility, the Netflix team pre-configures the appliances and fills them with the latest content. To avoid having the pre-filled content become stale, thereby requiring an extended high-traffic initial fill period, it is highly recommended to get the appliances online as soon as possible. You will be asked to confirm site readiness before any OCAs are shipped to you.

To facilitate smooth delivery and installation, you will be directed to an online site survey form before shipment where you can specify the final configuration details of your appliances. In this form, you will provide information such as:

- Site addresses
- Shipment contacts
- IP configuration details (IPv4, IPv6, default gateway, and so on)
- BGP configuration details (IPv4, and IPv6 if applicable)
- Type of rack rails (2-post vs 4-post)
- Power supply types
- Optic types

Each appliance is shipped with the parts that you specify in the online form.

### RECEIVING OCAS

Requirements for receiving an appliance shipment are roughly as follows. Specific requirements will be communicated to your logistics team by the Netflix logistics team before the shipment.

Criteria	Requirement
Estimated appliance weight	<b>100 to 125 pounds (45 to 57 kg)</b>
Estimated weight of pallet and	<b>63 pounds (29 kg)</b>

Shipping materials	
Loading dock and jack	Upon request, Netflix will ensure delivery trucks arrive with a pallet jack and lift gate if a loading dock and jack are not available at the destination.
Inside delivery	Inside delivery can be requested.

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## Racking and Physical Installation of OCAs

- [Racking and Installation](#)
- [Racking Guidelines](#)
- [OCAs Defective on Receipt](#)
- [Next Steps](#)

### RACKING AND INSTALLATION

Netflix ships each OCA to your requested location ready to deploy. As soon as you receive your OCA shipment, you are responsible for:

- Racking the appliance
- Providing the necessary 2-4 x 10Gbps (or 1 X 100G) optical network connections. Exact quantity depends on the appliance type.

**Reminder:** As mentioned earlier, because the content that is pre-loaded onto the appliances can become stale quickly, you should complete the installation as soon as possible.

#### **Airflow:**

- For global OCAs, optics face the cold aisle.
- For [flash-based appliances](#), optics face the hot aisle.
- For storage OCAs, optics might face either the hot or the cold aisle.

Airflow is marked on the OCA. If you are unsure about what type of OCA you are installing or have a question about airflow, [open a ticket](#).

OCAs are either 2- or 4-post friendly.

If you are racking a Global or Storage OCA, follow these instructions:

#### [Storage / Global OCA rail kit instructions](#)

If you are racking a Flash OCA, follow these instructions:

#### [Flash OCA rail kit instructions](#)

If you are using DC power, follow these supplemental instructions:

#### [DC Power Adapter instructions](#)

## RACKING GUIDELINES

- **Elevated Operating Ambient:** If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.
- **Reduced Air Flow:** Installation of the equipment in a rack should be such that the amount of airflow required for safe operation of the equipment is not compromised.
- **Mechanical Loading:** Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
- **Circuit Overloading:** Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.
- **Reliable Earthing:** Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

## OCAS DEFECTIVE ON RECEIPT

If an OCA is defective upon receipt, Netflix will send a Return Material Authorization (RMA) replacement appliance. For more information see: [Returns and replacements](#)

In the event of a hardware failure, please [open a ticket](#) for assistance.

## NEXT STEPS

After the initial installation, the next step is to establish a BGP session with the appliance, following the [network configuration instructions](#). After the session is established and the appliance begins reporting route data, the OCA will begin to receive fill traffic. Assuming that the appliance was installed within a [reasonable amount of time](#) after receipt, the fill process generally takes about two days. If installation was delayed, the fill process can take longer.

During the burn-in period, multiple checks are run on the appliance. You will receive periodic emails with the results of the checks. The appliance will not start serving client traffic until all checks pass and acceptable offload can be achieved. When the system is ready, the Netflix Open Connect operations team will enable the system to serve clients and will continue to monitor its performance.

- [railkit-2-4.pdf](#) (1 MB)
- [dc-power-supply-adapter-kit.pdf](#) (300 KB)
- [railkit-1.pdf](#) (3 MB)

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## Network configuration

This section describes how Open Connect Appliances are typically configured in a network. If you are an Open Connect ISP partner, Netflix works closely with you to determine the optimal configuration for your particular needs.

For more information, see the [FAQs](#)

- [Overview](#)
- [Router interface configuration](#)
- [Reconfiguring the IP address of an OCA](#)
- [Routing and content steering via BGP advertisements](#)
- [Clustering architectures](#)
- [Flash-based appliances](#)

## OVERVIEW

OCAs are *directed cache appliances*, meaning that the manner in which traffic is directed to the appliance is determined explicitly by you and by Netflix, not by the appliance itself.

An OCA only serves clients at IP addresses that you advertise to the OCA via a BGP session. In other words, traffic is only delivered from your embedded OCAs to the customer prefixes that you explicitly announce to them, as described in the following sections. Therefore, you as the ISP partner have full control over the networks that the appliances will serve. BGP sessions are established between appliance(s) and the closest connected router.

If content is requested that is not contained on an embedded OCA, the client request is directed to the closest Netflix content site via peering (if present) or via transit.

## RECONFIGURING THE IP ADDRESS OF AN OCA

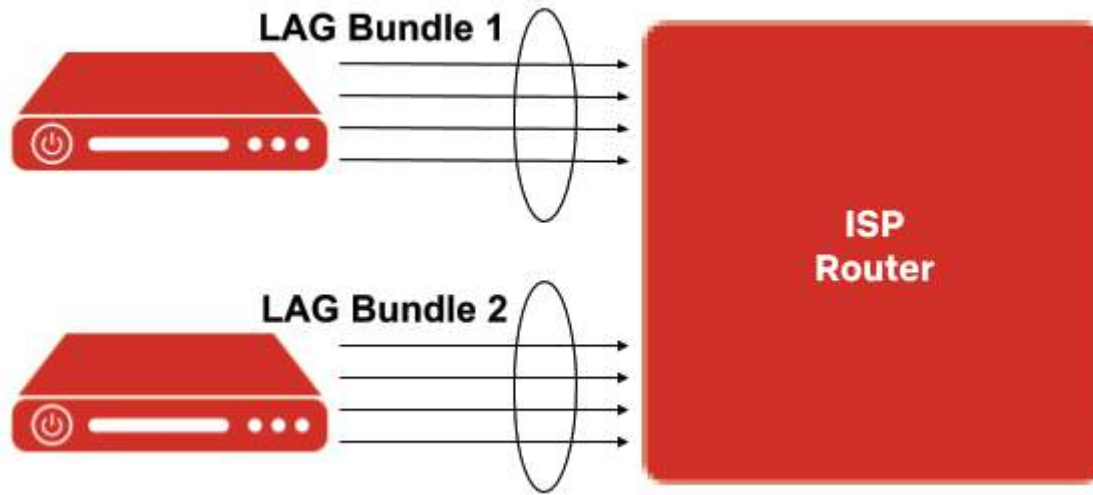
Each appliance comes fully configured based on the IP address details that you provided to Netflix in your site survey before it was shipped.

For step by step instructions on how to change the IP address of an OCA, see the following article: [Updating the IP address of an OCA](#)

## ROUTER INTERFACE CONFIGURATION

When you are connecting the appliances to your router, follow the guidelines in this section. See also [Example router configurations](#).

- Each OCA must be assigned one publicly routable IPv4 address, and it is highly recommended to also assign one IPV6 address.
- You can assign an address to the appliance from an IPv4 subnet of /31 and larger, or an IPv6 subnet of /127 and larger.
- It is acceptable to assign an address to the appliance from a larger subnet (for example, a /24). However, because only one IPv4 address is required per appliance, a smaller subnet is typically used.
- The router interfaces must be configured for Link Aggregation Group (LAG) with LACP. Each server must be configured in its own LAG bundle for the active interfaces on each server, as illustrated in the diagram below. In the two-server example configuration, there are two separate LAG bundles, one for each server.



- A standard maximum transmission unit (MTU) must be configured on each router interface. Jumbo frames are not supported.
- If there are multiple routers available that can provide redundancy in a site, it is recommended to stagger appliances between routers. Appliances on the same router should be in the same subnet to optimize filling. Appliances on separate routers should be in separate subnets. Appliances are not designed to be connected to two separate routers.
- All ports on an OCA should be connected to the same router or switch. Using multi-chassis LAG or switch stacking should be avoided.
- Each OCA is hardened against network attack and is designed to be directly connected to the internet. Filtering inbound or outbound traffic can cause operational issues, so we strongly recommend that you **allow all** traffic on all ports, do not use ACLs, and ensure that your router has a default route or full routing table. If you absolutely **must** filter, the current list of inbound and outbound usage follows. Please note that these can change at any time without prior notification.
  - **Traffic from OCA:** Allow all destination addresses and ports.
  - **Traffic to OCA:** Allow TCP 22, 53, 80, 179, 443, UDP 53 and 123 (source and destination), ICMP types 0, 3, 8, 11, and all ICMPv6 from any public IP/port. Allow all return traffic from any appliance-initiated connection (TCP established).
  - **Note:** You can confirm the status of required inbound/outbound OCA connectivity **in the Partner Portal**.
- Each network interface must be receiving between 0 dBm and -10 dBm of light to ensure good data throughput. The LCD panel on the front of the appliance displays the current light levels for each

interface. If your appliance does not have an LCD panel, access the console with a keyboard and mouse.

- For more information see the following related articles:
  - [Checking optical signal strength on an OCA](#)
  - [Troubleshooting input errors or low light levels on an OCA](#)

## ROUTING AND CONTENT STEERING VIA BGP ADVERTISEMENTS

We steer clients to our OCAs based on an ISP's BGP advertisements, coupled with the routing and steering algorithms in the Open Connect control plane. ISP partners can control some aspects of content steering via the BGP routes that are announced via peering or to each embedded OCA.

The control plane steers clients to the best available OCAs using a modified version of BGP best path selection. Assuming that the appliance has the requested title and available serving capacity, the control plane provides clients with a ranked list of appliances (typically 3 or more reliable sources) to stream from.

### APPLIANCE SELECTION CRITERIA

The following appliance selection criteria are considered, in order, by the Open Connect control plane services. If there is a tie for a given criterion, then the next criterion is considered. If there is a tie on all criteria, traffic is balanced between appliances.

1. The appliance that receives the most-specific route to the client's prefix.
2. The appliance that receives the route to the client's netblock with the shortest AS path. (See the [notes on peering](#) below).
3. The appliance that receives the route to the client's netblock with the lowest multi-exit discriminator (MED). (See the [notes on MEDs](#) below).
4. The geographically closest appliance. We geolocate based on client IPs, whose location is then compared to the latitude and longitude of nearby OCAs to determine the closest available system.

### ADDITIONAL NOTES ON MEDS

- We honor the MED values that we receive. However, we increase the value as follows depending on where we learn the prefix:
  - +0 for an embedded OCA (Netflix Cache server)
  - +50 for a direct peering connection (PNI)
  - +100 for peering at an IX (public peering)
- There is no cap on the maximum MED value.
- A missing MED is treated the same as a MED of 0, and indicates that the appliance should receive all servable traffic for the associated prefixes (also often referred to as *MED-missing-as-best*). Remember, if multiple appliances receive the same prefix with the same metric, traffic is load-balanced across those appliances. Because a missing MED will be equivalent to 0, it is preferred over any >0 MED on other appliances.
- **Important:** Marking MEDs on already installed and working Open Connect Appliances can be hazardous, because it must be done on all BGP sessions for all appliances at the same time.

Finally, a reminder that if you are peering with Netflix and do IRR filtering, our prefix set is RS-NETFLIX and our as-set is AS-NFLX. Please be sure to accept advertisements that originate from ASNs: 2906, 40027, and 55095.



See also: [Peering Locations](#).

## BGP REQUIREMENTS

- Route announcements for Open Connect embedded appliances:
  - IPv4 prefixes between /8 and /31 (inclusive) are accepted.
  - IPv6 prefixes between /19 and /64 (inclusive) are accepted.
- Route announcements for Open Connect peering sessions:
  - IPv4 prefixes between /8 and /24 (inclusive) are accepted.
  - IPv6 prefixes between /19 and /48 (inclusive) are accepted.
- As an implicit requirement, **all** appliances must have a BGP session configured in order to correctly participate in Netflix content steering and delivery.
- To localize traffic, the best practice is to advertise the most specific routes to the appliance. For example, if you are announcing a /22 to the OCA, but a /24 is received from the same block over settlement-free interconnection (SFI) peering or transit, the /24 will be preferred, delivering content traffic from the remote source instead of the OCA.
- If you are deploying only one OCA in your network, you should advertise the most specific (longest) prefix for that OCA over the peering session that you want the OCA to use for nightly filling purposes.
- If you are deploying multiple OCAs across more than one site in your network:
  - To enable efficient nightly fill: ensure that the appliances within one site can hear the subnets for the appliances in the other site via the BGP connection that is established with your router. See the [Fill and updates](#) information for more details.
  - See the additional information about [clustering architectures](#).
- Netflix does not use any BGP community information that is advertised by partners to OCAs or via Open Connect peering.
- Advertised routes that are received by an OCA are synchronized with Open Connect control plane services approximately every five minutes.
- Netflix uses RPKI-based route filtering. For more information, see: [RPKI-based route filtering](#).
- Netflix has joined the MANRS initiative. For more information, see: [Mutually Agreed Norms for Routing Security \(MANRS\)](#)

## TROUBLESHOOTING BGP ADVERTISEMENTS

There are a few tools in the Partner Portal that you can use to explore and troubleshoot BGP announcements:

- Use the [Route Explorer](#) to monitor the state of the BGP sessions and announcements that you have configured between your routers and the Netflix Open Connect Appliances that are embedded in your network.
- Use the [Route Optimizer](#) to run reports on your BGP route announcements. The [Route Optimizer](#) reports include all announcements that Netflix hears from your ASN(s), including at peering and embedded sites.
- View the [Route Performance Report](#) to discover prefixes in your network that are potentially experiencing relatively poor video streaming quality.

## EMBEDDED OCAS COMBINED WITH PEERING SESSIONS

The ideal Open Connect implementation is a mixture of both SFI peering and deployed embedded OCAs. Netflix uses two separate autonomous systems for peering:

- AS2906 is the AS number that Netflix uses for peering at its PoPs
- AS40027 is the AS number that embedded OCAs use to peer with ISP networks

See **BGP requirements** for prefix announcements that are accepted on peering sessions.

When OCAs and Open Connect SFI peering is combined, peering is used primarily for backup, for filling, and for serving long-tail titles.

Assuming that the AS PATH LENGTH to an embedded OCA and peering are equal, if you announce the same prefix both to a private or public peering session (using AS2906) and to an OCA (using AS40027) the OCA will be preferred over peering. This is because the Open Connect control plane will have two BGP entries for that prefix:

- one with an AS PATH LENGTH of 1 (<AS\_NUMBER>) from the appliance itself
- one with an AS PATH LENGTH of 2 (2906 <AS\_NUMBER>) from the peering location

Keep in mind the **appliance selection criteria** above and remember that the general best practice is to announce more specific routes to embedded appliances so that they are preferred for serving traffic.

## CLUSTERING ARCHITECTURES

Whenever more than one OCA is deployed in a site, they are configured by the Open Connect operations team as a single manifest cluster. OCAs in a manifest cluster share content storage and function together as one logical server/storage unit.

Although partners do not need to configure manifest clusters, it is important to understand some basic clustering concepts. In particular, there are implications to consider when OCAs in a cluster are taken down for maintenance or moved to a different site.

Clustering has the following potential benefits:

- **Greater offload for unique content**

In a typical two-OCA cluster, both appliances will use approximately 40% of their storage for the same popular content. This popular content typically represents roughly 60% of the OCA's total offload. The remaining 60% of storage space on each OCA is used to store a unique set of less-frequently-accessed content. Because we do not store the same exact set of content on each single OCA in a cluster, a cluster of OCAs provides greater total offload than an unclustered group of OCAs. This strategy helps the OCAs in a site function more efficiently.

For more information about storage strategies, see [this tech blog post](#).

- **Better resiliency**

Redundancy is generally acceptable in a two-OCA cluster. In the event of a single OCA failure, the healthy appliance will take over the majority of the traffic that the failed unit was serving. See the failover scenarios in the [sample architectures](#).

## NOTES FOR PARTNERS:

- After a set of OCAs has been installed in a site and grouped together as a cluster by the Open Connect team, they should be thought of as one big server. Therefore, any changes you make to a single OCA in a site has the potential to negatively impact the serving efficiency and behavior of the group.
- If you need to make changes to the OCAs in an established site - for example, if you intend to relocate an OCA from one site to another or disable one or more OCAs for a significant period of time - it is important to notify the Open Connect team so that they can make the necessary changes to the cluster configuration. Failing to do so can cause undesired consequences. For example, you may see traffic being steered to the wrong site, fill patterns may become suboptimal, and hot spots might develop.
- To enable optimal and balanced traffic patterns, OCAs in a site must receive the exact same BGP route advertisements. Therefore, if you relocate an OCA you must revisit your BGP route announcements to ensure that traffic continues to be steered appropriately.

## FLASH-BASED APPLIANCES

If you are an ISP with very large amounts of Netflix traffic, we will likely include flash-based appliances in your OCA deployment architecture. Flash-based appliances are 1U flash memory-based servers that are deployed when you reach a threshold number of OCAs, to augment the delivery capability of the main (storage) appliances.

- [railkit-1.pdf](#) (3 MB)

Article is closed for comments.



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## Example router configurations

Use the following examples to help you understand typical router configurations.

- [Brocade LAG BGP example](#)
- [Cisco IOS BGP example](#)
- [Cisco IOS XR BGP example](#)
- [Cisco IOS XR LACP example](#)
- [Cisco IOS Interface LACP example](#)
- [Cisco IOS XR Bridged Interface example](#)
- [Cisco IOS Switch with VLAN example](#)
- [Junos BGP example](#)
- [Junos Interface LACP example](#)
- [Junos Bridged Interface example](#)

### BROCADE LAG BGP EXAMPLE CONFIGURATION

```
lag "NETFLIX" dynamic
ports ethernet 1/7 to 1/8
primary-port 1/7
deploy
port-name "NETFLIX-OCA" ethernet 1/7
port-name "NETFLIX-OCA" ethernet 1/8
interface ethernet 1/7
enable
ip address <interface address/mask>
no ip redirect
ipv6 address <interface address/mask>
sflow forwarding
link-aggregate active
interface ethernet 1/8
enable
link-aggregate active

router bgp
neighbor Netflix peer-group
neighbor Netflix remote-as 40027
neighbor NetflixIPv6 peer-group
neighbor NetflixIPv6 remote-as 40027
neighbor <IPv4 address of Appliance> peer-group Netflix
neighbor <IPv4 address of Appliance> description "Netflix Open Cache Appliance"
neighbor <IPv6 address of Appliance> peer-group NetflixIPv6
neighbor <IPv6 address of Appliance> description "Netflix Open Cache Appliance"
```

```
address-family ipv4 unicast
neighbor Netflix prefix-list no-advertise in
neighbor Netflix prefix-list NETFLIX-LOCAL out
no neighbor NetflixIPv6 activate
exit-address-family
```

```
address-family ipv6 unicast
neighbor NetflixIPv6 activate
neighbor NetflixIPv6 prefix-list no-advertise-ipv6 in
neighbor NetflixIPv6 prefix-list NETFLIX-LOCAL-IPV6 out
exit-address-family
```

## CISCO IOS BGP EXAMPLE CONFIGURATION

```
!
router BGP <ASN>
neighbor <IP address of Appliance> remote-as 40027
neighbor <IP address of Appliance> route-map NETFLIX-OUT out
!
route-map NETFLIX-OUT permit 10
match ip address prefix-list NETFLIX-LOCAL
set metric 0
!
route-map NETFLIX-OUT permit 20
match ip address prefix-list NETFLIX-BACKUP
set metric 100
!
route-map NETFLIX-OUT deny 30
!
```

## CISCO IOS XR BGP EXAMPLE CONFIGURATION

```
!
router bgp <ASN>
neighbor <IP address of Appliance>
remote-as 40027
address-family ipv4 unicast
route-policy NETFLIX-OUT out
!
route-policy NETFLIX-OUT
if destination in NETFLIX-LOCAL then
set med 0
elseif destination in NETFLIX-BACKUP then
set med 100
else
drop
endif
end-policy
!
prefix-set NETFLIX-LOCAL
192.0.2.0/25,
192.168.100.0/25
end-set
!
prefix-set NETFLIX-BACKUP
192.0.2.128/25,
192.168.100.128/25
```

end-set  
!

## CISCO IOS XR LACP EXAMPLE CONFIGURATION

```
!  
interface Bundle-Ether1  
bundle minimum-active bandwidth 1  
ipv4 address <address/mask>  
ipv6 address <really-long-address/mask>  
!  
interface TenGigE0/0/2/0  
bundle id 1 mode active  
lACP period short  
!  
interface TenGigE0/0/2/2  
bundle id 1 mode active  
lACP period short  
!
```

## CISCO IOS INTERFACE LACP EXAMPLE CONFIGURATION

```
!  
interface Port-channel1  
ip address <address> <mask>  
!  
interface GigabitEthernet1/1  
channel-group 1 mode active  
channel-protocol lacp  
!  
interface GigabitEthernet1/2  
channel-group 1 mode active  
channel-protocol lacp  
!
```

## CISCO IOS XR BRIDGED INTERFACE EXAMPLE CONFIGURATION

For multiple servers with LAG, using the same default gateway.

```
interface BVI100  
description NETFLIX  
ipv4 address <address/mask>  
ipv6 address <really-long-address/mask>
```

```
l2vpn  
load-balancing flow src-dst-ip  
bridge group NETFLIX-OCAS  
bridge-domain NETFLIX-OCAS  
interface Bundle-Ether1  
interface Bundle-Ether2  
routed interface BVI100
```

```
interface Bundle-Ether1  
l2transport  
interface Bundle-Ether2  
l2transport
```

## CISCO IOS SWITCH WITH VLAN EXAMPLE CONFIGURATION

For multiple servers in LAG groups, behind a switch.

```
! SVI Configuration
!
interface Vlan30
description **NETFLIX OCA SERVERS**
ip address <address/mask>

! Port channel configuration
!
interface Port-channel31
description **LINK TO NETFLIX-OCA-1**
switchport
switchport mode access
switchport access vlan 30
!
interface Port-channel32
description **LINK TO NETFLIX-OCA-2**
switchport
switchport mode access
switchport access vlan 30

! Interfaces configuration
!
! OCA1
interface TenGigabitEthernet1/1/1
description **LINK TO NETFLIX-OCA1-TENO**
switchport
switchport mode access
switchport access vlan 30
channel-group 31 mode active
!
interface TenGigabitEthernet1/1/2
description **LINK TO NETFLIX-OCA1-TEN1**
switchport
switchport mode access
switchport access vlan 30
channel-group 31 mode active

! OCA2
interface TenGigabitEthernet2/1/1
description **LINK TO NETFLIX-OCA2-TENO**
switchport
switchport mode access
switchport access vlan 30
channel-group 32 mode active
!
interface TenGigabitEthernet2/1/2
description **LINK TO NETFLIX-OCA2-TEN1**
switchport
switchport mode access
switchport access vlan 30
channel-group 32 mode active
```

## JUNOS BGP EXAMPLE CONFIGURATION

```

protocols {
  bgp {
    group NETFLIX {
      neighbor <IP address of Appliance> {
        export NETFLIX-EXPORT;
        peer-as 40027;
      }
    }
  }
}

```

```

policy-options {
  policy-statement NETFLIX-EXPORT {
    term NETFLIX-LOCAL {
      from {
        prefix-list NETFLIX-LOCAL;
      }
      then {
        metric 0;
        accept;
      }
    }
    term NETFLIX-BACKUP {
      from {
        prefix-list NETFLIX-BACKUP;
      }
      then {
        metric 100;
        accept;
      }
    }
    then reject;
  }
}

```

## JUNOS INTERFACE LACP EXAMPLE CONFIGURATION

```

interfaces {
  ae1 {
    description NETFLIX-OCA;
    aggregated-ether-options {
      lacp {
        active;
        periodic fast;
      }
    }
    unit 0 {
      family inet {
        address <address/mask>;
      }
      family inet6 {
        address <really-long-address/mask>;
      }
    }
  }
  xe-0/0/0 {
    description NETFLIX-OCA-cxgbe0;
    ether-options {
      802.3ad ae1;
    }
  }
}

```



```

    }
  }
  xe-0/0/1 {
    description NETFLIX-OCA-cxgbe1;
    ether-options {
      802.3ad ae1;
    }
  }
}

```

## JUNOS BRIDGED INTERFACE EXAMPLE CONFIGURATION

For multiple servers with LAG, using the same default gateway

```

vllans {
  NETFLIX-OCAS {
    vlan-id 100;
    l3-interface irb.100;
  }
}
interfaces {
  irb {
    unit 100 {
      family inet {
        address <address/mask>;
      }
      family inet6 {
        address <really-long-address/mask>;
      }
    }
  }
  ae0 {
    description NETFLIX-OCA-1;
    unit 0 {
      family ethernet-switching {
        vlan {
          members NETFLIX-OCAS;
        }
      }
    }
  }
  ae1 {
    description NETFLIX-OCA-2;
    unit 0 {
      family ethernet-switching {
        vlan {
          members NETFLIX-OCAS;
        }
      }
    }
  }
  xe-0/0/0 {
    description NETFLIX-OCA-1-PORT1;
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/1 {
    description NETFLIX-OCA-1-PORT2;
    ether-options {

```

```

    802.3ad ae0;
}
}
xe-0/0/2 {
  description NETFLIX-OCA-2-PORT1;
  ether-options {
    802.3ad ae1;
  }
}
xe-0/0/3 {
  description NETFLIX-OCA-2-PORT2;
  ether-options {
    802.3ad ae1;
  }
}
}

```

Article is closed for comments.



OPEN CONNECT

## RPKI-based route filtering

- Beginning on February 24, 2020, Netflix enabled RPKI filtering on BGP sessions to embedded Open Connect Appliances (OCAs)
- Beginning on September 2, 2020, Netflix enabled RPKI filtering on all peering and transit BGP sessions

Resource Public Key Infrastructure (RPKI) provides a method for networks who have been assigned IP addresses to specify which ASNs are authorized to originate those IP address prefixes via route origin authorizations (ROAs), which are stored and distributed by the regional Internet registries.

By implementing RPKI-based filtering, Netflix is honoring the wishes of ISPs who have chosen to opt into the RPKI ecosystem to protect their IP address space. For ISPs who have not signed their address space, there is no impact.

If you want to check your embedded route announcements to ensure that your ROAs match the routes that Netflix is receiving, you can do so by running a **Route Optimizer report** in the Partner Portal.

**Note:** The **Route Optimizer** report currently does not identify filtered routes that are announced on peering or transit sessions.

Because RPKI-based filtering is being deployed by an increasingly large number of network operators and internet exchange points, the value of signing your address space continues to increase. If you have not yet signed your address space, we recommend that you consider doing so.

For more information about RPKI, see these additional resources:

- <https://www.arin.net/resources/manage/rpki/>
- <https://www.ripe.net/manage-ips-and-asns/resource-management/certification/what-is-rpki>
- <https://www.lacnic.net/1150/1/lacnic/rpki-faq>

Article is closed for comments.



OPEN CONNECT

## Mutually Agreed Norms for Routing Security (MANRS)

Netflix encourages the ISPs we partner with to follow industry best practices in order to build and operate a safer internet. We have adopted Mutually Agreed Norms for Routing Security (MANRS) standards, and we encourage our partners to do the same. MANRS is a global internet safety initiative, supported by the Internet Society.

MANRS standards help the internet community (ISPs, CDNs, and IXs) reduce the most common routing threats, which helps ensure the stability and security of the entire internet ecosystem.

For more information about MANRS, see the information on their [website](#).

Article is closed for comments.



OPEN CONNECT

## Fill patterns

Each Open Connect Appliance (OCA) stores a portion of the Netflix catalog, which in general is less than the complete content library for a given region. Popularity changes, new titles that are added to the service, re-encoded movies, and routine software enhancements are all part of the nightly updates, or *fill*, that each appliance must download to remain current.

## FILL WINDOWS

By design, OCAs follow a “push fill” methodology. They fill every day during a window of time that corresponds to your off-peak hours. The timing of the fill window is defined in partnership with your network planning team.

The goal is to set the fill window such that:

- It occurs during the trough of your Netflix traffic
- It does not disrupt your inbound traffic peaks

Setting the fill window this way allows the system to continue to download updates and serve clients without negatively impacting playback performance.

Requirements for the fill window, by hardware type:

Setting	Storage	Global	Flash
Length of time	<b>12 hours</b>	<b>12 hours</b>	<b>12 hours</b>
Timeframe	<b>2AM to 2PM (local time)</b> (can be shifted +/- 2 hours)*	<b>2AM to 2PM (local time)</b> (can be shifted +/- 2 hours)*	<b>2AM to 2AM (local time)</b> (can be shifted +/- 2 hours)*
Bandwidth	Maximum rate of <b>1.2 Gbps per system</b>	Maximum rate of <b>0.4 Gbps per system</b>	Maximum rate of <b>0.3 Gbps per system</b>
Total traffic during fill window	Up to <b>6.5 TB</b>	Up to <b>2.1 TB</b>	Up to <b>1.6 TB</b>

\*All OCAs within a site must begin filling at the same time.

The system might complete filling before the end of the fill window, and it might fill more than once if new content becomes available before the fill window ends.

Most flash-based appliances can fill and serve simultaneously, but some older hardware revisions cannot. These older revisions are configured to fill as much as possible from the storage appliances that are on site, and Netflix traffic is served by the storage appliances on site during their fill period.

For more information about changes to fill patterns that were made after October 2020, see **Media-aware content placement**

## FILL PATTERNS

In general, appliances determine where to receive fill using selection criteria that is similar to **the steering criteria that is used by Netflix client devices**. The following scenarios provide more detail.

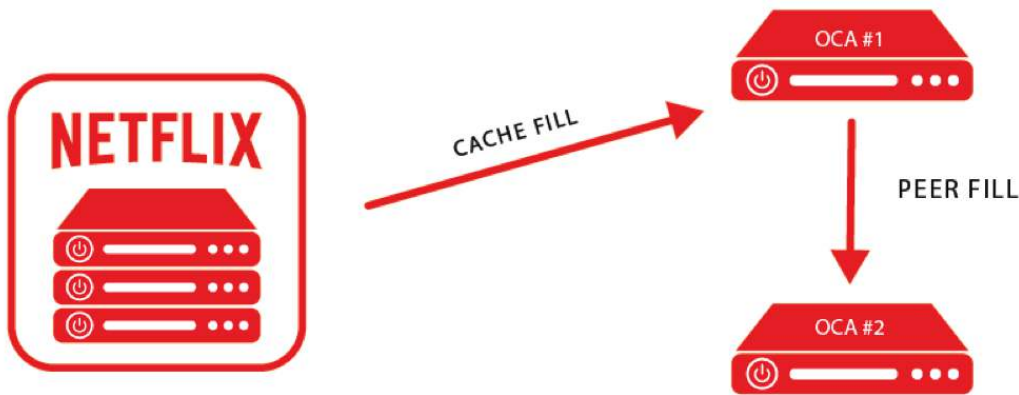
If you have specific fill requirements, discuss them with your partner engagement manager during the initial site design process. If you require changes to your appliance's fill behavior post-deployment, **open a ticket**.

### PEER FILLING

OCAs will attempt to peer fill from each other in either of these two cases:

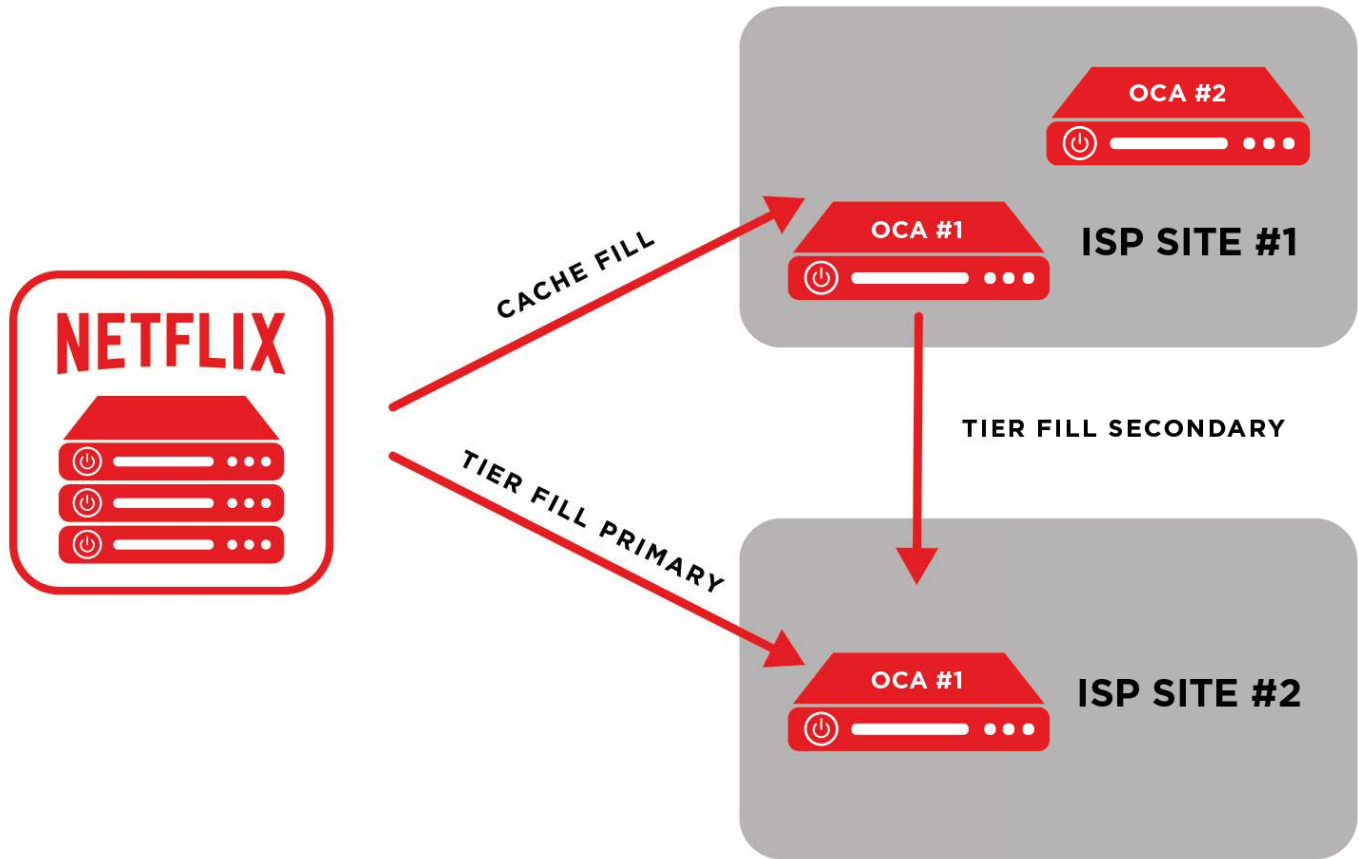
- If they are clustered
- If they are on the same subnet

For example, assume that in the following diagram, OCA #1 and OCA #2 are in a cluster. If OCA #1 downloads a movie via a regular cache fill, OCA #2 will then seek to download the movie from OCA #1 instead of via transit or Open Connect peering. Routes to the OCAs must be advertised over Open Connect peering to ensure that the peering session is used for fill traffic.



## TIER FILLING

Peer filling is the most efficient method, however as a second-best option tier filling is considered. OCAs that can see each other's IP address in their BGP feed (but are not in the same cluster or subnet) will consider filling from each other rather than via a regular cache fill.



## OUT-OF-CYCLE FILLS

There will be cases that cause an urgent need to deploy or update a small subset of titles on the OCAs outside of the normal fill window. This need can arise for various reasons, for example:

- If re-encoding of a popular title is required to repair viewing issues
- To make a new, “day-of-broadcast”, or “day-after-broadcast” title available

When these out-of-cycle fills occur, you will see a small portion of fill traffic for a limited period of time outside of the configured fill window. Doing an out-of-cycle fill instead of waiting until the normal fill window helps to ensure that popular titles can continue to be served from your OCAs (the preferred method) and not via peering or transit. This approach improves the overall efficiency and offload potential of the system. Because out-of-cycle fills are limited to very specific popular titles, they do not negatively impact overall server efficiency - rather, they increase the local offload of popular content.

See also: [This blog post about fill](#)

Article is closed for comments.





OPEN CONNECT

## Automatic Software Updates

Netflix manages the OCA software, and we will periodically update or enhance the software. All non-emergency software updates are performed during the configured fill window, and you will be notified when the update starts and after it is complete. All appliance software, including the operating system, web server, and control code, is updated as a single image.

If a new image fails to properly load, the appliance will automatically fall back to the previous image. In most cases, any issues that occur can be resolved on our end and there is no partner action required. If an upgrade fails and we need help resolving the issue, we will open a ticket to your organization.

Article is closed for comments.



OPEN CONNECT

## Health Monitoring

As part of the Open Connect program, Netflix continuously monitors all deployed Netflix OCAs, including all aspects of the performance and availability of the appliance. In addition, you can monitor the basic health of the OCAs that are deployed on your network by using the Netflix Partner Portal at <https://my.oc.netflix.com>. You will be invited to create an account in the Partner Portal as part of the OCA installation and turn-up process.

Article is closed for comments.



OPEN CONNECT

## OCA Maintenance Policies

- [Partner Maintenance](#)
- [Unplanned Outages or Service-Impacting Events](#)
- [Potential Service-impacting Maintenance](#)

### PARTNER MAINTENANCE

The only OCA components that Netflix will request partners to replace in the field are:

- Power supplies
- SFP+ optics

We will ship these components to you in case of failure. Netflix will not request any ISP partner to install or replace any internal OCA hardware components such as memory, hard drives, or fans. Note that OCAs are designed to operate in data center environments with high-capacity fans that are required to cool the dense disk and memory installed. You might notice loud fan noise from OCAs, which is normal.

For ISP partners who are engaging in maintenance that might impact Netflix OCA availability, please observe the following guidelines:

- Plan your maintenance or downtime to occur during the scheduled fill window in order to minimize service disruption to our shared subscribers.
- You can disable and drain appliances from the Open Connect Partner Portal following these instructions: [Draining and disabling appliances](#)
- If you schedule maintenance in advance in the Partner Portal, a notification will be sent to the Netflix team on the day the maintenance occurs.
- Plan to drain appliances of traffic 2 to 3 hours in advance of disconnecting or powering down appliances, so that sessions that are currently associated with the appliance will finish by the start of the maintenance period and new Netflix viewing activity is directed to an alternate source.
- After completion of maintenance, please ensure that the OCAs are re-enabled to serve traffic. This will redirect new session starts away from the alternate sources.
- If you intend to make any changes to a site that contains multiple OCAs in a cluster, you must notify the Open Connect team so that the cluster can be reconfigured properly. For more details, see the information about [clustering architectures](#).

### UNPLANNED OUTAGES OR SERVICE-IMPACTING EVENTS

For service-wide outages with broad impact to the service of multiple OCA partners, partners might receive an initial notification, status updates on a regular basis if the outage is prolonged, and a final resolution notification. If you want to filter these announcements, the sender address is: [cdn-noc@mailier.netflix.com](mailto:cdn-noc@mailier.netflix.com).

For per-ISP partner incidents, including routing and connectivity anomalies that persist over a significant period of time, the Netflix operations team will be alerted by our internal monitoring tools. We will resolve any issues under our control as soon as reasonably possible. If there is an issue that requires partner assistance, we will open a ticket to you.

## POTENTIAL SERVICE-IMPACTING MAINTENANCE

Whenever possible, for any planned maintenance or activity that might adversely impact an OCA or the services that it provides, Netflix will communicate according to the following schedule:

1. Netflix will send an email at the start of any maintenance activity.
2. Netflix will send another email when the maintenance activity is completed, to signal the return to a normal operational state.

For emergency service activities that do not permit our standard advance period, we will notify as early as possible.

During scheduled and emergency Netflix maintenance windows, ISP partners might see their BGP session flap, notice a link-state change with their cache-connected interfaces, and see traffic served from the appliance decrease or go to zero. All of these events are expected.

Under normal conditions, software updates that are not service-impacting will occur during the fill window at a time of low traffic, thereby minimizing potential user impact.

Article is closed for comments.



OPEN CONNECT

## Returns and Replacements (RMAs)

- [Appliance RMA guidelines](#)
- [Parts returns and replacements](#)

### APPLIANCE RMA GUIDELINES

Open Connect Appliances (OCAs) are designed for resiliency, including the ability to have multiple hard drives fail without a noticeable impact on delivery. At times, however, hardware performance might degrade to a point where replacement of the entire OCA is necessary to maintain the ability to offload traffic in a meaningful manner.

In general, RMA requests are initiated by the Netflix NOC team, who will reach out to ISP partners via email and request for them to fill out a site survey form to start the RMA process.

Our standard process is to ship a pre-loaded replacement OCA within three business days. The partner then returns the impacted hardware in the same shipping box, and Netflix pays shipping both ways, at no shipping cost to the partner. Instructions for how to return a defective appliance are included in the shipping box when you receive the replacement appliance.

#### Important:

- If we request for you to return a defective appliance, we will not set the new replacement appliance to serve live traffic until you submit the OCA return form via the **Partner Forms** application.
- Please note that the title to your appliance will transfer to Netflix upon Netflix's receipt of the Appliance in its designated **US** repair facility.

In some instances, we might need additional time in order to fully pre-load content for specific geographic regions. The total time until shipment from our US facility is likely to be 10 US business days at most, however customs clearance can vary according to region and country and might delay final receipt.

### PARTS RETURNS AND REPLACEMENTS

As discussed in the [maintenance article](#), we might ask partners to replace PSU or SFP+ optics on an appliance. In such cases we will ship the replacement part to the partner, and we might also request that they return the defective part.

To return a defective part, follow these instructions:

1. Keep the packaging box for the RMA return. Please reuse the same packaging material.
2. Remove or black out old shipping label including the barcode(s).
3. Place the return shipping label on the most visible part of the packaging box.

4. Ship your package using one of the following methods:

- Via Fedex:
  - Use your regular scheduled Fedex pickup.
  - Drop off at FedEx. Find the closest location at <https://www.fedex.com/locate>.
  - Schedule a pickup online. Go to <https://www.fedex.com/grd/rpp/>.
- If you do not have a Fedex Center close by, contact Open Connect Logistics. Please send an email to [CDNL@netflix.com](mailto:CDNL@netflix.com) requesting the pickup. Include the following information:
  - Pickup address
  - Contact name and phone number
  - Netflix NCO ticket number

Article is closed for comments.